DSD Characteristics of a Mid-Winter Tornadic Storm using C-band Polarimetric Radar and Two 2D-video Disdrometers

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ABSTRACT

Drop size distributions in an evolving tornadic storm are examined using C-band polarimetric radar observations and two 2D-video disdrometers. The E-F2 storm occurred in mid-winter (21 January 2010) in northern Alabama, USA, and caused widespread damage. The evolution of the storm occurred within the C-band radar coverage and moreover, several minutes prior to touch down, the storm passed over a site where several disdrometers including two 2D video disdrometers (2DVD) had been installed. One of the 2DVDs is a low profile unit and the other is a new next generation compact unit currently undergoing performance evaluation.

Analyses of the radar data indicate that the main region of precipitation should be treated as a "big-drop" regime case. Even the measured differential reflectivity values (i.e. without attenuation correction) were as high as 6-7 dB within regions of high reflectivity. Standard attenuation-correction methods using differential propagation phase have been "fine tuned" to be applicable to the "big drop" regime. The corrected reflectivity and differential reflectivity data are combined with the co-polar correlation coefficient and specific differential phase to determine the mass-weighted mean diameter, D_m, and the width of the mass spectrum, σ_M, as well as the 'intercept parameter', N_w. Significant areas of high D_m (3-4 mm) were retrieved within the main precipitation areas of the tornadic storm.

The "big drop" regime assumption is substantiated by the two sets of 2DVD measurements. The D_m values calculated from 1-minute drop size distributions reached nearly 4 mm, whilst the maximum drop diameters were over 6 mm. The fall velocity measurements from the 2DVD indicate almost all hydrometeors to be fully melted at ground level. Drop shapes for this event are also being investigated from the 2DVD camera data.

The high D_m and σ_M regions are tracked using data collected with high temporal resolution PPI scans of the tornadic storm. We present here the methodologies used to determine the DSD parameters from the radar observations, the resulting

DSDs as time series during the storm evolution and the (qualitative) consistency between the two sets of 2DVD measurements and the DSDs estimated from the C-band observations.